BrainSpace® – A distributed cognitive system for innovation

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Abstract

The problems managers face increasingly gain of complexity, and innovation takes place more and more beyond the boundaries of the enterprise. Therefore new methods and tools are necessary to foster multiple stakeholder relationships and manage distributed knowledge creation. This paper addresses some of the key considerations for collaboration and innovation, and derives an integral approach which combines different web-based tools and methods to a distributed cognitive system. Sustainable solutions require procedures that combine the effectiveness of a team with the creative power and the expertise of a community. BrainSpace fills this gap, and allows innovation to proceed in a complex environment by striking a balance between order and creative chaos.

Keywords

Open Innovation, Collaborative Environment, Distributed Cognitive System, Knowledge Construction

1. Innovation as a Cognitive Process

The innovation process deals with complex and sometimes wicked problems that contain an evolving set of interlocking issues and constraints. Until a solution is developed, problems often must be solved without full understanding of the problem. A non-linear and complex process is necessary to find a solution. Sometimes the requirements can even change during the process. Also, in this social process there are many stakeholders with divergent interests who care about how the problem is solved since the results affects them.

For a better understanding of collaboration, we must first look in general at the cognitive interaction of individuals. Our basis for understanding cognitive processes comes from the concept of constructivism, e.g. [Watzlawick 1976], [Maturana/Varela 1992], [Glasersfeld 1997], [von Foerster et al. 2000]. According to constructivism, there is no one universal reality (objective reality), but each person has their own view of reality (subjective reality). When we absorb information from outside the world, only aspects that can be related to our current mental models will penetrate into our consciousness. Ideally, we can match the incoming information with our mental models. A difference between our perception and our patterns leads to perturbations, which forces us to rebuild our mental models. If the difference is too large, no association can be made, and we have no understanding of the incoming information (Fig. 1).

In the context of collaboration and innovation, we are particularly interested in the process where two persons (A and B) communicate in order to develop a common understanding of a topic. Communication is more than just the exchange of information. However, it is not possible to transmit information between A and B in the objective sense. That is, if A says something to B, it is not possible for B to know what is happening in A's mind, and vice versa. We feel that communication is closer to the Latin verb 'communicare', which means 'to share'. Therefore persons A and B will start a process of sharing in order to develop this common understanding.

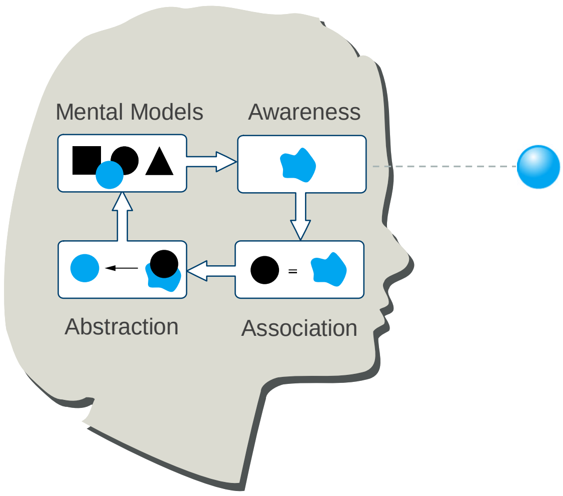

Figure 1: Cognition as a process of adapting and constructing new mental models [Ninck, 2007]

The concept of collaboration goes one step further: not only does A and B strive for a better understanding of each other, but they also are in a mutual social process of designing new mental models for themselves. Schrage [1995] brings up this point when he defines collaboration as: "two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own".

Important to our work is questioning the required means and conditions for mutual thinking and learning within a virtual space. Representatives of activity theory believe that individual consciousness is shaped substantially by activities: "Consciousness is located in everyday practice: you are what you do" [Nardi, 1996]. The close connection between activity and consciousness is also emphasized by [Jonassen 2000]: "The conscious understanding is an essential part of the activity that cannot be separated from it." Activity theory asks in particular for tools which support our activities: "An activity always contains various artefacts (e.g. instruments, signs, procedures, machines, methods, laws, forms of work organization). An essential feature of these artefacts is that they have a mediating role" [Kuuti, 1996]. As discussed above, communication and collaboration is more than a simple exchange of information by transmitting and receiving signals - it is the common construction of mental models. During this process activities and mediating artefacts obviously play a key role: "the use of culture specific tools shapes the way people act and think" [Jonassen 2000]. Schrage [1995] focuses on the significance of the space within the context of sharing. He assumes that in a collaborative context it is mandatory that symbols, pictures, models or concepts are processed within a shared space. Figure 2 summarizes some substantial demands on an environment for collaborative activities: shared space must not only enable optimal signal transmission and reception of signals, but should also support the cognitive process using artefacts.

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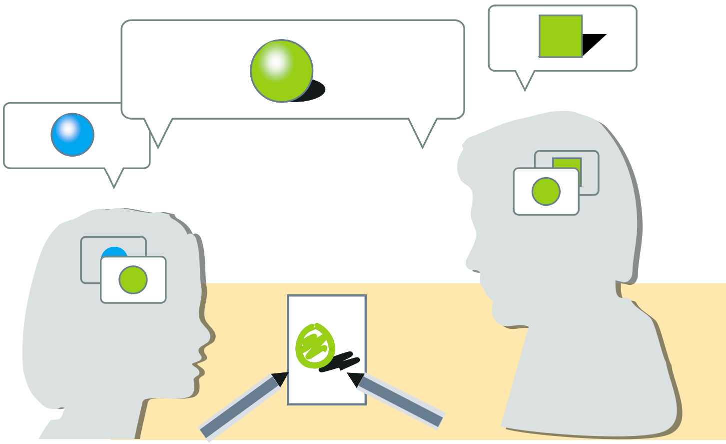

Figure 2: Communication and collaboration is more than information exchange – space and artefacts are mediators in the cognitive process

As a consequence of constructivism and activity theory, the potential for creativity and innovation should increase if we provoke perturbations using artefacts. Collaborative groups can represent a suitable environment for this purpose. The effect is optimal when there is a certain deviation of the mental models within the group; however, this should not be so strong that communication is blocked. The conditions are best within new groups, as older groups have the tendency to develop paradigms [Kuhn, 1991] that cannot be easily changed. Group members acknowledge themselves mutually and adapt their mental models within the group. In addition, mature cognitive systems have the tendency to homeostasis [Vicari/Troilo, 2000], so that in case of disturbance they tend to move back towards the initial state. If we intend to create a stimulating environment for innovation, we should compose heterogeneous groups that collaborate for a certain time. Nadler [1988] calls this approach ‘frame breaking’.

The inclusion of different stakeholders with multiple perspectives is crucial in order to break deep-rooted patterns of thinking. We need organizational structures which allow autonomy, redundancy, variety and even chaos, while also needing a method to bring concerned persons together to create confidence and bind agreements under time restrictions. Therefore, collaborative groups should be organized free of hierarchy. We have to strive for a synergistic collaboration rather than a conflicting separation among the participants [Brown/Duguid, 1991].

2. Computer Supported Knowledge Creation

The method we propose is called *BrainSpace*, which is based on the Team Syntegrity model invented by Stafford Beer [Beer, 1994]. While Syntegrity defines general structures for the exchange within social systems, *BrainSpace* focuses on a collaborative innovation process, enlarging the Syntegrity model regarding space and time. The architecture of the model can be illustrated by using the structure of an icosahedron (Fig. 3). Each member of the large group is represented by one connecting edge. Each vertex corresponds to a topic. Five edges lead to each vertex; therefore five persons constitute a team, studying one topic. Each member is an active player on two different teams, as represented by the edge connecting two vertices. In addition, the members take a role as critical observers and facilitators within two other groups. Attending different teams, a member contributes what he or she has learned in an adjacent team, and the available information is progressively distributed over the entire network.

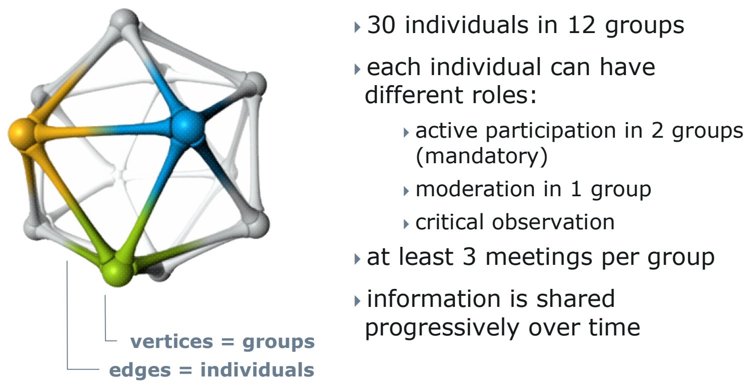

Figure 3: *BrainSpace* architecture

Different polyhedra models are appropriate for different group sizes. An icosahedron with 12 vertices and 30 edges models 30 persons studying 12 topics. An octahedron with 6 vertices and 12 edges models 12 persons and 6 topics. The polyhedral structure of the Syntegrity model allows finding a balance between order and creative chaos. In addition, the process of reverberations dissolves “the paradox of peripherality (alienation, low morale) versus centrality (effective action) of actors in an organization” [Schwaninger, 2001].

The original Syntegrity model consists of rigid protocols. For example, the length of a Syntegration must take place between three and five days, and during this time all members must be present. Therefore, the method requires considerable resources of time. Also innovation needs a steady process. “Only if firms can continuously feed and renew the creative tension, they will be able to catalyze innovation in a complex environment” [Shawney/Prandelli, 2000]. *BrainSpace* enables a continuous process since its protocol allows communication in a virtual environment between geographically distributed stakeholders.

Tools to create a shared space and to support the tasks in *BrainSpace* provide multiple asynchronous and synchronous communications among the distributed participants. Important features such as application and file sharing, chat rooms, messaging and calendar functions are covered by common products. These products are continually being enhanced, and others are being introduced regularly. Therefore, the general functions, as opposed to the specific products, are given priority in the development of *BrainSpace*.

Summed up, *BrainSpace* is a model for organizing processes of communication in social systems, in particular for distributed collaborative innovation. The virtual sessions happen in an environment which offers ideal prerequisites for innovation since:

- there is a fast, purposeful collaboration within a distributed setting
- the heterogeneous groups integrate individual strengths and different points of view, producing an environment rich in perturbations
- the available information is efficiently distributed and documented
- the process breaks former behavior patterns and hierarchical decision making
- the different roles provide self-reflection and social skills

- the individual's active participation fosters personal commitment, group cohesion, and a sense of responsibility

3. BrainSpace in Practice

We have tested the *BrainSpace* approach several times with more than hundred students from different Universities and different disciplines. We also have applied *BrainSpace* within a community of practice called 'Forum New Learning' which aims at sharing knowledge on using new learning technologies. After a period of knowledge exchange in a rather traditional way by means of electronic discussion boards the members started to criticize that there is a lack of innovative *new* knowledge. With *BrainSpace* we therefore intended to start a process of knowledge construction. A third application of *BrainSpace* was the moderation of a strategy building process within the ICT department of a Swiss bank. The main goal of this application was to involve the middle management (about 60 persons) in the implementation phase of the strategy process. And actually we have started a *BrainSpace* application with a global marketing team of another Swiss bank. Table 1 shows the general tasks of the *BrainSpace* process.

Task		**Description**
Opening (asynchronous communication is given priority, if members don't know each other, kick-off should be local or synchronous)	*Kick-off*	Model explanation. Stakeholder introduction. Goal presentation. Installation and verification of the used tools.
	Problem-description	Problem analyzing and topic wording by stakeholders. The contributions are explicated by a superordinated opening question.
	Topic-auction	Topic reduction (number depends on the type of polyhedron), and assignment of topics to stakeholders according to individual preferences (by use of an optimization algorithm).
	Agenda-setting	The individual teams determine the dates for the meeting within a time window. Observer and moderator roles are assigned. Moderators and observers become familiar with their roles.
1st Virtual Session (above all synchronous communication, asynchronous tools for documentation and planning subsequent actions)		The teams explore their respective topic. A moderator facilitates the discussion. Results and agenda are written up and put in a forum, visible to everyone. Members from non-active teams observe the discussions and give feedback. The duration of a meeting is about 60 minutes.
2nd Virtual Session		Same setting like 1st virtual session.
...		According to the situation further virtual sessions may be added.
Finalization (synchronous communication is given priority)		Presentation of conclusions. Planning for subsequent action. Assessment.

Table 1: General tasks of the *BrainSpace* process

For asynchronous communication, documentation, and knowledge management we have used Wiki pages with the students, Microsoft SharePoint with the members of 'Forum New Learning', the open source collaboration platform DotNetNuke with the strategy process, and a combination of SharePoint and Wiki pages with the global marketing team (cf. Fig. 4 and 5). For synchronous communication and collaboration we are using the web conferencing tool Centra from Saba.

Here are some results of the ongoing evaluation:

- The users found BrainSpace an interesting and inspiring approach in comparison to traditional group and project work.
- The literacy to handle the technical facilities is crucial, technical problems can push the main goal into the background and reduce the motivation.
- A thorough introduction is the key for a proficient application of the method.
- The computer mediated communication works fine and is not seen as a barrier. On the contrary, some of the users feel less inhibition than in face-to-face situation.
- Willingness to experiment with the features of the new technology is high, and it increases during the project.
- The get-together phase is important. Computer supported collaboration requires a certain amount of confidence.
- It has proven effective and efficient to delegate as much of the responsibility to the groups. For example it is much easier for the group members to organize their own agenda than following a predefined schedule.
- The users appreciate the fact that the moderating team facilitates the sessions in the first online phase. Some of them even would prefer to see an external facilitator during all group activities.
- It is important to have a critical observer, on one hand for giving feedback to the group, and on the other hand for learning a lot about the dynamics in the ongoing process.

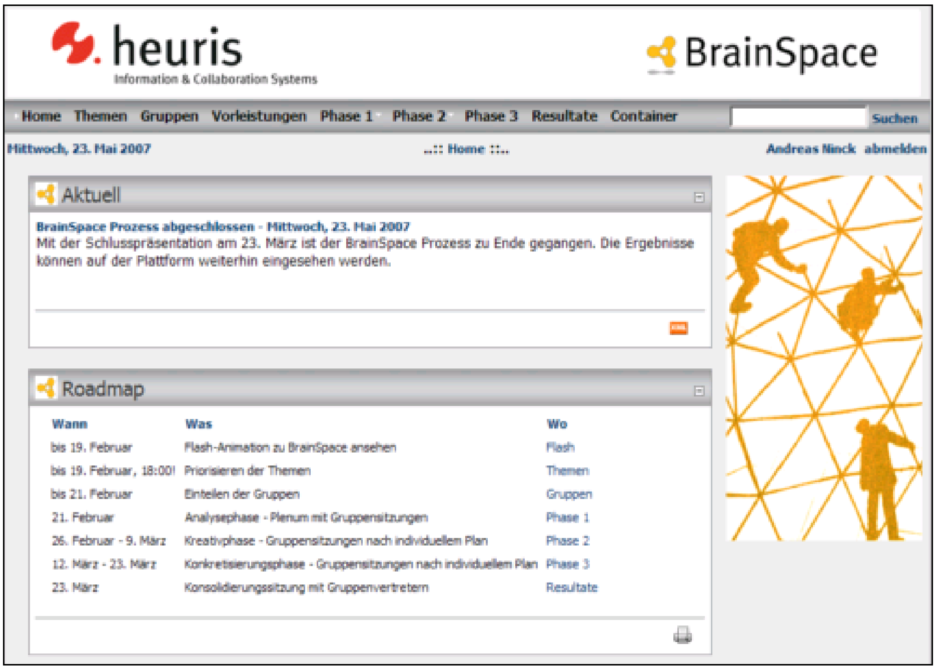

Figure 4: *BrainSpace* with DotNetNuke

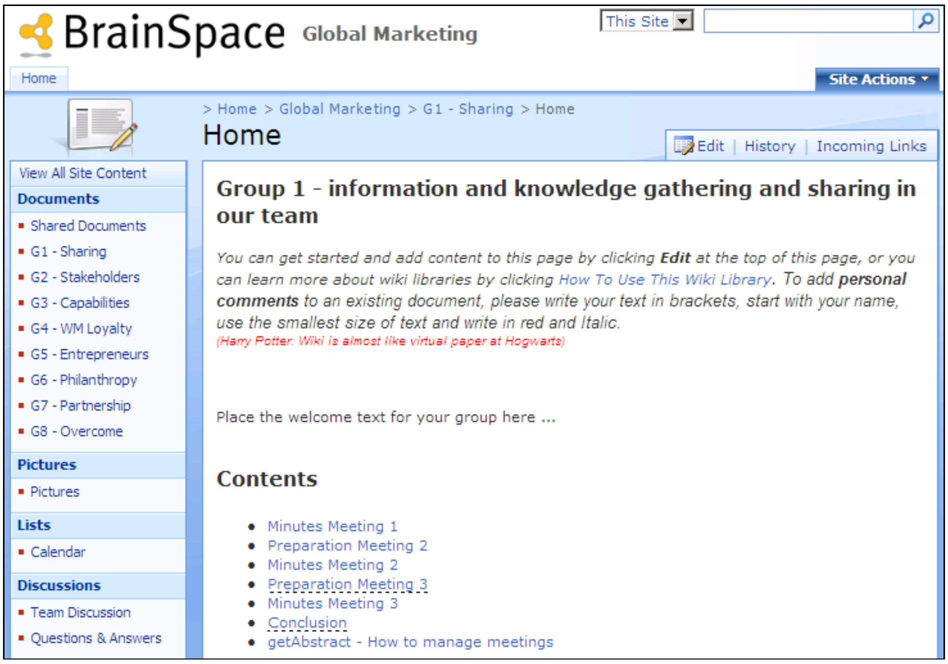

Figure 5: *BrainSpace* with SharePoint combined with Wiki

4. Conclusion

The challenge for innovation is to enable a satisfactory balance between order and chaos, change and stability, intellectual property and the collaborative mental model development among the diversity of stakeholder relationships. To reach this we are setting up a temporary organization with a restricted amount of resources. The structures of *BrainSpace* run orthogonal to the existing organization and allow multiple stakeholders to be involved in a virtual environment. We not only propose to share explicit knowledge, but also enforce all participants to construct tacit knowledge within a collaborative process.

Shared spaces and mediating artifacts permit a problem-oriented relationship that implies continuity and therefore a participative development of solutions. These relationships are the essential breeding ground for innovation. A well-specified communication protocol keeps the process on track, but the overall procedure is flexible and can be adapted to specific conditions and requirements. Finally, it becomes possible to introduce perturbations without risk for the corporation. We are convinced that *BrainSpace* solves to some extent the paradoxical demand to introduce disorder and to organize creative chaos.

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